Forest Pest Management

Special
Report R2-75-1

Review of Mountain Pine and Other Forest Insects Active in the Black Hills

1895 to 1974

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PREPARED BY: R. GREGORY THOMPSON

APPROVED BY:

G. L. DOWNING
Staff Director
Forest Pest Management

Review of Mountain Pine Beetle and Other Forest Insects Active in the Black Hills[1]

1895 to 1974[2]

From the time settlers first noted the fading and dying of trees in 1895 to the present time, the mountain pine beetle (Dendroctonus ponderosae) has been causing serious tree losses in the Black Hills Forest. Epidemics have been recorded in 1897, 1931, 1946, 1957, 1962, 1967, and 1972. Tree and volume losses from 1895 to the present time have been so catastrophic that reliable figures are impossible to calculate. Many factors are responsible for the beetle outbreaks, but the major problem lies with overstocked, secondgrowth, stagnated stands. Little progress has been made in the past towards control of the beetle. Solution rests with proper stand management by State, private and Federal agencies. The problem will likely persist for many generations, but efforts are being made to bring the entire Black Hills Forest under proper stand management. Whether it be by direct stand management or by beetle kill, the forest stands will eventually attain a stable uniformity

Historical Review

On February 22, 1897, the Black Hills Reserve was set aside containing 967,680 acres. Administration of the Reserve was under the General Land Office of the Department of Interior. Reports from 1897 indicated that an estimated 3,000 acres of bug-killed trees were reported in Limestone Divide from Crooks Tower to the head of Little Spearfish Canyon. No control action was taken at this time, but studies were made and specimens sent to the Bureau of Entomology for analysis in 1898 and 1899. These specimens were considered to be a distinct species and peculiar to that area. Thus it was given the name Black Hills Beetle (D. ponderosae). No action was taken to control the outbreak at this time.

In 1901, Griffith made a survey of the Reserve and found 225,000,000 board feet of infested timber in 116,000 acres. A. D. Hopkins also ran a survey at this time and recommended that large patches of newly hit trees be located, marked, cut and peeled before the first of May. Since no market existed for the timber, all efforts taken failed.

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[1]Review compiled and written by R. Gregory Thompson

[2]Compiled from available records and more review may find additional information

In 1902, many facts concerning the conditions in the Black Hills were published, but few control efforts were made. The Bureau of Entomology experimented with trap trees but had little success in controlling the beetle infestation. Hopkins reported that a large percentage of merchantable timber had been killed, and that 80% of the timber west of Spearfish Creek to the Wyoming line was dead. Professor H. S. Graves made known his findings at this time (1902) from a survey he took in 1897. He stated that the Black Hills Reserve had an area of about 1,200,000 acres by 1902, and that 1,442,000,000 feet of sawtimber and 13,500,000 cords of other material existed. Others estimated that the Reserve had between 2.5 and 4 billion feet of timber. Annual growth was set at 50 million feet. Insect damage on the Reserve varied from 200 million to 600 million feet. Insect damage in 1900 was reported at 9% of all standing timber. Because the infestations were scattered, estimates of damage given were more guesswork than thorough findings. Graves recommended at this time that timber be cut only in infested ares; that sales include green, infested and dead trees; that slash work continue on timber sold in the sale; that tops below 8" be left to discretion of buyer (for use as cordwood); that timber in nonaccessible areas be left but, amounts and locations be recorded, and that purchasers be required to peel and hew bark of infested trees or that mills burn slabs and edges of infested trees. With no control measures taken since 1895, the peak of infestation and damage occurred during 1903-1905. It was recorded that some infested trees were marked and cut, but to a minimal degree.

On February 1, 1905, the Forest Reserve was transferred from the Department of Interior to the Bureau of Forestry in the Department of Agriculture. Shortly after this, the Bureau became the Forest Service.

By 1906, a total of 300,00 board feet of timber had been cut. This was a small portion compared to the total kill. Cost of the cutting was $9/M. The market for timber was still minimal at this time. To create a larger market, the Agriculture Appropriation Act of 1907 was passed and allowed for the export of dead and infested timber from South Dakota. This bill was retroactive to include that timber cut in 1906. This provided a better market for timber. Timber sales were started in 1906-1907, but restrictions were placed on trees cut between 9-14 inches in diameter. Because of this restriction, little progress was made.

450,000 board feet of timber was cut in 1907 at a cost of $5.50/M. Cost per tree averaged 81¢. An experiment with peeling standing trees was tried on 350 trees at a cost of 27¢ per tree. It was also noted that a fungus in dying trees infested with beetles was killing the beetles in the larval stage. This fungus, called the bark peeler, caused bark to separate from the wood and fall off and expose the larva, thus killing them. It is not known how widespread the fungus was.

1907-08 brought increased sales of solid blocks of heavily infested areas. These sales produced about 1 million board feet of timber at an average cost of $2.50/M.

Extreme conditions existed in 1908 from the east line of the Reserve to almost the southeast corner of the Reserve, and the southwest quarter of the Limestone area with 35% of the timber affected. Sales were advertised containing 250 million feet of infested timber. Average cost per tree was 30¢. Total capacity of mills operating within the Forest at that time was about 90 million feet per annum; average cut for the forest had been 27 million feet per annum. Timber peeled at this time cost $.50/M and timber cut was sold at $2.00/M.

1909 showed no new infestations were occurring and it was thought that the infestation was completely over.

By 1910, one half of the Black Hills Reserve (Limestone Divide Area) had a large percentage of timber destroyed. Throughout the remaining area of the reserve showed scattered large and small patches of infested timber with reports that between 1 and 2 billion board feet of timber had been killed.

On July 1, 1911, the Black Hills Reserve was subdivided into the Harney National Forest with headquarters in Custer and the Black Hills National Forest with headquarters in Deadwood.

Data from 1911 to 1914 is missing, so no records of events are known.

In 1914, the Black Hills and Harvey Forests reported sporadic infestations killing between 1-15 trees per area. Timber sales and free use were used to remove infested trees. Annual reports were required to check abnormal infestations and keep outbreaks in check. Reports are not available from 1915 to 1918, and conditions for that period are unknown. Statistical reports in 1924 show removal of infested trees in 1916 and 1917.

Reports in 1919 stated that scattered infestations prevailed throughout both Forests, but the infestations were in a quiescent state. In 1920, the Black Hills and Harney Forests undertook cleanup on small patches of concentrated infestation by free use, sales or commercial cutting. Both Forests reported stable conditions.

1921 reports showed that both Forests were reporting light infestations and no drastic changes.

Information is not available from 1922 through 1928. Little damage occurred during this time, as reported in 1929. Statistical reports listed timber removed in 1922 and 1923.

1924 Statistical Insect Control Work

Year	Acreage	Total volume (bd. ft.)	Cost	Cost/bd. ft.
1906		300,000	$2,700.00	$ 9.00
1907		450,000	2,475.00	5.50
1907			114.50	
1908		1,000,000	2,500.00	2.50
1914		15,400	186.50	1.21
1916		4,270	93.30	21.85
1917		59,796	579.16	9.67
1919		354,392	2,501.64	7.05
1920		240,328	2,600.03	10.79
1922		7,770	99.24	12.77
1923		56,180	1,230.07	21.89

Reports in 1929 stated that little damage had occurred since 1919. Occasional trees were reported killed each year. Plans were made to harvest mature timber and cut up to sustained yield in seriously damaged areas in the future, if warranted.

Small outbreaks in 1930, were reported in two areas. Local use was proposed to dispose of the infested trees. Deep Creek showed a buildup and it was suggested to treat or utilize trees in that area. A buildup was also noticed in a windthrow area.

Areas of Infestation in 1930

Little Elk Creek--29 trees found infested on 5 acres. Arrangements made to fell, peel, and burn infested trees.

Deep Canyon--640 acres infested--520 acres Federal land, remainder private. Three hundred trees per section died in groups of 3-50. The infestation may have been caused by a cyclone which hit the area (400 acres) in 1927 and weakened trees. One million bd. ft. was damaged by the storm and 60% of timber windthrown. Cutting of trees was proposed.

Infestations were found on Hay, Deep, Little Elk, and Cord Creeks, and Lost Canyon in the Black Hills Forest iin 1931. Five hundred dollars was allocated for insect control for the Black Hill Forest and Bearlodge District. No noticeable outbreaks were found throughout the Harney Forest and control was maintained through the use of timber sales.

1932 surveys and checks made throughout both Forests showed no serious infestations. Scattered small infestations were numerous as a result of 1931 attacks. Control of these infestations was accomplished by free use

and timber sales. The Bearlodge District did extensive control work on treated areas. Areas of control were in Deep Creek, Middle Fork Hay Creek, Cub Gulch, Pearson Draw, Fawn Creek, Harding Gulch, North Redwater, and Sawmill Gulch.

1932 Insect Control Work

Area	Private			Federal		
	Acres	No. trees	Bd. ft.	Acres	No. trees	Bd. ft.
Fawn Creek	10	1	1,415			
Harding Gulch	80	7	2,560			
North Redwater	320	4	730			
Sawmill Gulch	160	3	3,400			
Deep Gulch	320	38	9,980	320	94	33,270
Cub Gulch	40	15	1,985			
Pearson Draw	40	1	85			
Middle Fork Hay Cr.	160	57	12,310	40	23	2,525
	140	524	82,478	100	151	16,545
	80	75	8,370			
Insect Control	1,350	725	123,313	460	268	52,340
Admin. Use		102	11,390			

Treated: 983 trees; C/T treated: 93¢, TC - $919.13; TC/T: $1.49; Time: 848 hrs.

Report from 1933 indicated that neither Forest had large infestations, and attacked trees that were located were controlled through free use. The heavy infestation in the Bearlodge District was controlled in 1932 by intensive treatment. In 1934, the Black Hills Forest reported an increase in infestation over 1933 and control measures were taken. Harney reported minor infestations throughout the Forest.

1934 Insect Control Work

Forest	Acres	Trees treated	TC	C/T	Man-day use
Black Hills	451	1,215--F.S. 100--free use	$387.26	32¢	50
Harney	1	12--free use			

1935 showed that both Black Hills and Harney Forest had no serious infestations, and only light, scattered areas of infestations.

1935 Insect Control Work

Forest	Acres	Trees treated		TC	C/T	Man-day Use
Harney	0	2	2	$11.32	$5.66	4

Both Forests again reported no serious or large outbreaks in 1936, and in areas where infestations were present, the infested trees were treated.

1936 Insect Control Work

Forest	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills	500	10	10	$121.54	$12.15	37
Harney	62	44	44	127.32	2.89	65

A buildup in infestation was apparent in 1937 on the Black Hills Forest and measures were undertaken to reduce the outbreak. Harney reported light infestation with little change from the previous year.

1937 Insect Control Work

Forest	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills	15	37	37	$214.98	$6.03	61
Harney	23	69	69	319.15	4.62	182

1938 brought widespread infestation throughout both Forests. Most portions of the Black Hills Forest had endemic levels of infestation. Four control projects were undertaken; Surprise Gulch on the Spearfish District was the most intensively hit. A heavy snow storm in 1937 caused breakage of trees in this area and aided in the beetle buildup. Hit trees ranged from 6-10" in diameter. Groups ranged from 5 to 49 trees per group. 800 trees remained to be treated in 1939 and the Stewart Gulch area on the Pactola District showed need of treatment. Three projects were undertaken on the Harney Forest with the project on the District the most intensive. Two minor projects in the spring and fall involved 50 trees treated in each project. For the most part, Harney Forest showed little infestation in remaining areas. It was reported that there were 150 infested trees on two sections of Jewel Cave National Monument and between 1,000 and 2,000 infested trees in Custer State Park.

1938 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
West Nugget (12/12,14-27/38)	1	6	6	$ 94.48	$15.75	37
Castle Creek (9/15/38)	1	1	1	32.57	32.57	13
Surprise Gulch (10/1-12, 31/38)	3,200	3,015	3,015	6,459.23	2.27	2,590
Limestone (9/1-11,14/38)	6	6	6	38.03	6.34	14
	3,208	3,028	3,028	$6,624.31	$ 2.32	2,654
Harney NF						
Harney (11/7-12,31/38	15,642	2,240	2,215	$9,681.33	$ 4.37	4,775
Boles Canyon (3/1-15/38)	640	62	62	338.13	5.45	151
East Side (1/5-3,5/38) (7/27-8,11/38)	600	56	15	401.79	7.17	97
	16,882	2,358	2,292	$10,421.25	$ 4.47	5,023

Heavy infestations were still present in 1939 on the Black Hills Forest. A survey showed 28,928 acres of ponderosa pine type had 4,090 infested trees.

By fall of that year, 15,000 of the 28,928 infested acres had been treated. Control work was carried into 1940. Surveys taken on the Harney Forest showed no serious infestations. There was an area with about 200 infested trees on it that needed treating. Control work showed 514 trees removed on 11,200 acres and spring and fall control efforts removed 5,846 and 1,588 infested trees.

1939 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Spearfish-Limestone						
(1/1-7,1/39)	3,200	950	950	$3,332.73	$3.51	1,670
Spearfish-Limestone						
(11/1-12,31/39)	15,000	1,624	1,359	6,104.75	4.49	2,327
Nemo						
(4/5-6/30/39)	2,200	558	558	1,136.34	2.04	597
Pactola						
(6/1-6/30/39)	10	21	21	92.20	4.39	41
Rochford						
(6/5-6,29/39)	4,500	138	138	785.00	5.69	363
	24,910	3,291	3,026	$11,451.02	$3.78	4,998
Harney NF						
(1/1-6,9/39)	36,280	5,622	5,590	$20,073.09	$3.59	8,438
(12/1-12,31/39)	5,620	256	256	1,079.49	4.22	570
(2/1-6,12/39)	6,620	1,258	1,258	2,637.47	2.10	1,449
(12/1-12,31/39)	4,480	331	331	626.37	1.82	410
	53,000	7,467	7,435	$24,416.42	$3.28	10,867

In 1940, the Black Hills reported principal control work was done in the Spearfish-Limestone area with scattered areas in the Rochford District. The Spearfish-Limestone area by 1939-40, had an additional 2,600 trees treated over 30,000 acres. 1,000 untreated trees remained, with control work expected. The Harney Forest reported endemic levels in the Forest and control was done in areas where infestations were located.

1940 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Spearfish-Limestone						
(1/1-7,6/40)	14,900	1,317	1,317	$6,866.50	$5.21	2,640
Spearfish-Limestone						
(11/1-12,31/40)	3,000	161	143	1,020.19	7.13	334
Rochford						
(1/1-7,1/40)		81	81	210.72	2.60	85
	17,900	1,559	1,541	$8,097.41	$5.25	3,059
Harney NF						
(1/1-6,10/40	19,436	1,173	1,167	$4,658.40	$3.99	2,512
(1/1-1,31/40)	1,480	100	100	524.85	5.25	269
(1/1-6,15/40)	6,500	409	409	1,380.37	3.37	404
	27,416	1,682	1,676	$6,563.62	$3.92	3,185

Moderate infestations on the Black Hills Forest were reported in 1941, and control work was done in three areas. The Limestone area had 400 infested trees on 7,000 acres; area to be treated if economical. Harney had no heavy infestation but control work was done on small scattered areas in the Bear Mountain area and on the east side of the Forest. Control was conducted mostly through timber sales.

1941 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Spearfish						
(1/1-6,28/41)	10,700	817	813	$2,200.00	$2.71	1,040
Rochford-Nemo	50	45	45	90.00	2.00	48
(6/1-6,30/41)						
Limestone						
(12/10-12,31/41)	1,500	65	65	195.00	3.00	73
	12,250	927	923	$2,485.00	$2.69	1,161
Harney NF						
(2/10-4, 21/41)	4,780	700	700	$1,228.62	$1.76	454
(1/1-6,16/41)	11,100	697	697	1,751.16	2.21	1,039
	15,880	1,397	1,397	$2,979.78	$2.13	1,493

In 1942, the Black Hills and Harney Forests showed a decrease in activity with continuing maintenance control. Harney still used timber sales as a control measure in the maintenance program.

1942 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Castle Creek						
(1/15-6,1/42)	5	12	12	$14.61	$1.22	2
Limestone						
(1/6-7,19/42)	200	20	17	56.44	3.32	18
	205	32	29	$71.05	$2.45	20

Harney NF 19 - Cut and treated through sale

1943 showed that the Black Hills Forest had endemic levels of infestation except on Rochford and Limestone Districts where heavy infestations occurred. Harney showed favorable conditions with no control work being done. Infested trees were removed through timber sale cutting throughout the Harney Forest.

1943 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Castle Creek						
(7/27-8,5/43)	30	25	25	$ 101.50	$4.06	22
Limestone						
(5/5-6, 15/43)	4,000	254	254	890.55	3.51	151
Little Spearfish						
(1/22-1,23/43)	240	3	3	21.93	7.33	6
No Name						
(5/1-5,10/43)	--	12	12	15.50	1.29	4
	4,270	294	294	$1,029.48	$4.05	183

Harney NF 200 - Cut in timber sale

Generally, 1944 showed stable conditions throughout both Forests. Infestations in the Black Hills Forest were scattered and at a low level except for the Rochford and Limestone Districts where heavy infestations were reported. The Harney Forest reported no increasing infestations with timber sales being used as control for removal of infested trees.

1944 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Pactola District						
(5/29-30/44)	20	12	12	$ 26.91	$2.24	4
Swede Gulch						
(6/21-7,14/44)	48	207	207	383.47	1.85	74
Limestone						
(5/1-6,30/44)	26,000	553	551	1,914.68	3.47	230
	26,068	772	770	$2,325.06	3.02	308
Harney NF		20 - Cut in sale				

N. D. Wygant, in the Forest Insect Situation in Region 2 report, dated 1945, states that between 1935 and 1944, $80,000 was spent in treating 24,000 infested trees in the Black Hills.

1945 showed an increasing trend of infestation for both forests. In the Black Hills Forest, the Limestone and Spearfish Districts showed a significant increase in infestations. The Harney National Forest also showed increasing activity but no control measures were taken.

1945 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Limestone						
(5/1-7,21/45)	222	113	113	$ 647.35	$5.73	95
Pactola District						
(5/4-7/45)	200	763	369	1,409.71	4.28	108
	422	876	482	$2,057.06	4.65	203

The Black Hills Forest, in 1946, reported insect activity present on all Districts. Control work was being done and it was estimated that between 11,000 and 12,000 trees were infested. The Rocnford and Bearlodge Districts had the heaviest infestations. The Harney National Forest reported control measures were taken on the Moon and Alkali-Bull Springs areas which showed the heaviest infestation areas.

1946 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Tunnel Gulch (1/3/46-4/15/46)	300	55	55	$ 10.00	$ --	1
Buskala Creek (6/15-7,15/46)	200	190	190	15.80	--	1
Scale Spur Mystic (6/2-7,15/46)	1,000	171	171	116.09	.68	18
Castle Creek (6/2-7,15/46)	?	?	?	?	?	?
Willis Reynolds (12/12-18,31/46)	900	299	--	39.88	6.02	4
Silver Creek (12/18-12,31/46)	100	229	46	327.37	6.02	25
Limestone (5/6-12/46)	2,000	470	296	704.72	2.38	--
Nemo District (11/1-6,10/46)	1,340	585	585	641.60	1.10	113
Spearfish District (1/1-6,27/46)	--	76	76	199.48	2.63	28
Spearfish District (12/1-12,31/46)	--	94	41	202.40	4.95	21
Bearlodge (11/25-13,31/46)	960	150	150	836.31	5.67	72
Pactola District (6/5-6,6/46)	1	4	4	24.00	6.00	3
Pactola District (11/12-16,31/46)	4	50	30	155.63	5.19	18
	6,805	2,373	1,644	$3,273.28	$1.95	304

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Harney NF						
Moon (12/5-12,31/46)	200	436	359	$1,349.92	$3.76	69

From 1942 to 1946 beetle work was reduced because of World War II. By 1946, epidemic infestations were occurring and control measures were needed. Adequate funds were not available, so by the fall of 1947 a large-scale program was necessary. An emergency appropriation was requested of Congress and a bill was passed allocating $235,000 for control work. Plans were made and agreed upon and a spray program begun. Orthodichloro benzene was used on standing trees. 45,949 trees were treated on 177,000 acres by July of 1948 and treating operations were complete. Of this acreage, 42,440 were treated by the Forest Service at an average cost of $4.32/tree. The State of South Dakota treated 1,506 trees and Homestake Mining Company treated 2,003 trees. A total of 3,477,000 bd. ft. of timber was treated.

Infestations in 1947 showed an increase on both Forests from 1946. Large infestation areas in the Black Hills Forest were: Bearlodge, 7,000 trees; Limestone, 20,000 trees; Rochford, 2,500 trees; Spearfish, 9,000 trees. Control measures and spray projects were taken with 1,200 trees sprayed. The Harney National Forest reported increased infestations with control projects in progress.

1947 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Sandpit (1/1-7,19/47)	2,721	2,684	2,670	$5,308.27	$1.99	517
Sandpit July 1947)	100	--	1,200	2,780.14	2.32	70
Sandpit (10/12-26,12/47)	14,176	936	605	1,350.00	2.23	158
Limestone (1/1-2,14/47)	500	71	132	520.84	3.95	48
Limestone (9/12-21,31/47)	14,500	1,894	421	1,390.75	3.90	124
Pactola (11/12-12,31/47)	3,000	155	155	881.06	5.68	88
Silver Creek (1/1-7,22/47)	5,340	2,321	2,321	7,378.96	3.18	824
Willis Reynolds (1/1-7,15/47)	900	--	299	55.86	.19	6
Castle Cr./Besant Pk. (11/1-12,15/47)	790	224	224	1,224.00	6.55	147
Castle Cr./Cleaver Draw/Silver Cr. (11/1-12,17/47)	700	179	143	815.00	5.70	10
Castle Cr./Crooked Cr. (10/4-10,30/47)	400	67	--	33.64	.50	--
Spearfish (1/1-6,30/47	400	400	301	1,510.36	5.02	135
Spearfish (10/12-27,31/47)	1,225	675	612	1,690.92	2.76	138
	44,752	9,606	9,083	$24,939.80	$2.75	2,265

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Harney NF						
Moon (1/1-7,10/47	1,280	1,540	1,540	$4,021.00	$2.49	283
Moon (9/12-22,31/47)	1,640	1,440	731	2,160.00	2.95	182
Hell Canyon-Pleasant Valley (12/3-31/47)	120	445	339	1,211.00	3.57	102
	3,040	3,425	2,610	$7,392.00	$2.83	567

Infestations in 1948 reached epidemic levels. The Black Hills Forest continued control work and reported heavy infestations. The Harney Forest showed an appreciable increase in new infestations which were scattered throughout the Forest and also in areas where control had been concluded in the first half of 1948. Custer State Park treated 162 infested trees.

1948 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Rochford (1/1-3,6/48)	1,300	644	644	$ 3,319.74	$5.15	21
Rochford (10/3-12,17/48)	27,141	424	424	2,295.39	5.41	--
Limestone (10/11-12,31/48)	1,100	611	524	1,919.79	3.66	14
Limestone (1/19-3,30/48)	6,000	2,879	2,879	7,906.01	2.75	--
Spearfish (11/14-12,17/48)	1,900	438	438	1,692.93	3.87	15
Bearlodge (9/27-12,24/48)	1,840	1,499	1,139	4,880.51	4.29	41
Forest Pest Control (3/7-7,22/48)	43,000	30,136	30,136	130,437.05	4.33	--
Private Land (3/7-7,22/48)	3,000	2,035	2,035	8,808.90	4.33	--
	85,281	38,666	38,219	$161,260.32	$4.22	91

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Harney NF						
National Park (3/7-7/22/48)	10,000	72	72	$ 54.00	$ --	--
Harney (11/15-12,31/48)	13,000	1,747	1,747	10,432.00	6.00	49
Forest Pest Control (3/7-7,22/48)	50,000	9,897	9,897	42,837.08	4.33	--
Custer State Park (11/1-12,31/48)	17,000	212	162	2,471.06	15.25	17
Custer State Park (3/7-7,22/48)	65,000	1,506	1,506	6,609.80	4.39	--
	155,000	13,434	13,384	$62,403.94	$4.67	66

In 1949, the Black Hills Forest continued to have epidemic levels of infestation, but at a reduced scale from that of 1948. Additional treatment was necessary as well as cleanup work. The Harney Forest was still doing control work with maintenance control expected after the spring treatment.

A survey taken in 1948 showed an infestation on Custer State Park which was serious enough to warrant action. Between 6/21 and 7/10 of 1949, 841 trees were treated in Custer State Park. Post-control evaluation in the fall of 1949 showed 146 new infestations with treatment recommended.

1949 Insect Control Work

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Black Hills NF						
Forest-wide (4/20-7,23/49)	85,385	9,948	9,886	$29,625.00	$3.00	1,608
Harney (7/1-23/49)	14,000	2,668	2,668	10,606.41	3.98	420
	99,385	12,616	12,554	$40,231.41	$3.20	2,028

Area and dates of treatment	Acres	Trees Treated		TC	C/T	Man-day Use
Harney NF						
Forest-wide (5/2-7,23/49)	206,000	3,040	3,040	$12,085.26	$3.98	478
Moon (Willow Spr.) (12/5-17/49)	8,320	1,070	1,070	4,878.42	4.56	250
	214,320	4,110	4,110	$16,963.68	$4.13	728

In 1950, both the Black Hills and Harney Forests were continuing control work and infestations were still reported throughout the whole "Hills" area. Maintenance control was deemed necessary for the following year.

Condition Report to Washington in 1950

Black Hills and Harney Forests

Control Period: 5/25/50 to 8/10/50

Total Infested acres: 350,000

Treatment: Spraying with orthodichloro benzene

No. of trees treated: BHNF: 5,451; HNF: 384

Cost: 048 - $20,345.64

148 - $ 6,134.81

$26,480.45

Cost/tree: $5.53 **Man-day Use:** 1,504

Reports in 1951 indicated that both Forests were continuing a maintenance control program with infestation still widespread.

Condition Report to Washington in 1951:

Black Hills NF	Harney NF
Infested Acreage: 125,000	Infested Acreage: 400
Control Period: 6/18/51 to 8/11/51	Control Period: 5/1/51 to 7/31/51
Treatment: Spraying with orthodichloro benzene	Treatment: Spraying with orthodichloro benzene
No. of trees: 1,050	No. of trees: 193
Total Cost: $7,419.34	Total Cost: $1,395.10
Cost/tree: $7.07	Cost/tree: $7.23
Man-day Use: 452	Man-day Use: 79

No change was reported in 1952. Both Forests continued maintenance control work with no large outbreaks.

Condition report to Washington in 1952:

	Black Hills NF	Harney NF
Acreage	150,000	25,000
Control Period	6/28/52 to 8/9/52	6/17/52 to 7/26/52
Treatment	Spraying with orthodichloro benzene	Spraying with orthodichloro benzene
No. of trees treated	292	193
Total Cost	$2,764.83	$1,395.10
Cost/tree	$9.47	$7.23
Man-day Use	145	79

In 1953, the Black Hills and Harney Forests were consolidated into one Forest-the Black Hills National Forest. Maintenance control work continued and infestations remained at a fairly low level.

Condition Report to Washington in 1953:

	Black Hills NF	Harney NF
Control Period	6/15/53 to 8/10/53	6/1/53 to 7/31/53
Treatment	Spraying with orthodi-chloro benzene	Spraying with orthodi-chloro benzene
Acreage	150,000 (N.F.)	6,000 (N.F.) 1,000 (Private) 160 (Other)
No. of trees treated	500	350 (N.F.) 30 (Private) 10 (Other)
Total Cost	$5,000	$1,850
Cost/tree	$8.30	

Infestations still persisted throughout the Black Hills, and reports from 1954 indicate that maintenance control continued in infested areas.

Condition Report to Washington in 1954:

Treatment: Spraying with orthodichloro benzene

No. trees treated: 1,311

30. Total cost: $5,648.70

Cost/tree: $4.31

In 1955 maintenance control work was expanded and logging was used again as a control measure. Use of chemicals on standing or felled trees continued. 800 trees were treated in 1955.

The Forest reported no new change in beetle activity in 1956, with infestations at endemic levels. Maintenance control work continued with logging and treating of infested trees. 900 trees were treated in 1956.

Most of the Black Hills reported little infestation in 1957 with maintenance control being maintained. Bear Mountain showed a substantial increase in infestation, 1399 trees were treated with ethylene dibromide.

Comparing Intensity of Beetle Activity By Acres

	Light	Moderate	Heavy	Total
Bear Mountain 1957	17,940	150	20	18,110

Bear Mountain reported an epidemic level of infestation in 1958, with other areas in the Black Hills remaining fairly stable. Maintenance work continued. Bear Mountain treated 4,085 infested trees in 1958.

Intensity of Infestation by Acres

	Light	Moderate	Heavy	Total
Bear Mountain 1958	32,910	1,010	1,180	35,100

Infestations remained light throughout most of the Forest in 1959, with control measures continuing wherever infestations were found. Intensive efforts in the Bear Mountain area had checked the epidemic. 7,010 trees were treated at a cost of $24,180.

Maintenance control work continued in 1960 in infestation areas, and reports indicated a declining trend in the infestation. A total of 20,297 trees were chemically treated in the Bear Mountain area before the infestation was controlled.

A survey taken in 1961 in the Crows Nest and Limestone areas, indicated an increasing infestation trend in the northern Black Hills. Surveys show a 3.5:1 buildup ratio. Annual maintenance control was a management tool in the Forest to contain infestations. Trees surveyed averaged 17.6" in diameter or greater. Data was collected in second-growth ponderosa pine type. Drought conditions had prevailed for several years, a primary factor in the spread and increasing trend of the infestation.

By 1962, outbreaks in the northern Black Hills were increasing at a rapid rate. The most serious outbreak was in and around Deadwood, S.D. The State of South Dakota and the Forest Service planned joint control projects for treatment of 20,680 infested trees. Evaluations taken in the Bear Mountain, Limestone, Pactola, and Spearfish Districts and the exemption area around Lead-Deadwood indicated an increasing infestation. Trees sampled averaged 14.1" in diameter and varied between 65 and 140 years in age. An estimated area of one-quarter million acres thinned in 1930 by CCC crews had once again reached the point where thinning was required. Due to this overstocking, and continued drought conditions, beetle activity mushroomed. There was a need for increased control programs by Forest and State managers to contain the infestation and keep it at an endemic level.

The outbreak in 1963 extended from north of Custer westward to the Bear Mountains in Wyoming. Nearly 25 million board feet of pine was killed, and 16,800 trees were treated.

1963 Combined Infested Land in Black Hills

Lands in South Dakota			Lands in Wyoming		
	Infested Trees			Infested trees	
N.F.	137,240		N.F.	28,920	
BLM	10,000		BLM	4,000	
S&P	57,000		S&P	6,240	
	204,240	+		39,160	=

243,400 Total No. of Infested Trees

The Northern Black Hills faced a serious epidemic. The principle infestations were on Bear Mountain, the northern half of Elk Mountain, the western half of the Rochford District, the southern half of the Spearfish District, and the western half of the exemption area. There was a large infestation in the Limestone area reported, and 25,000 trees were chemically treated. These stands remain overstocked and large chemical control projects were considered necessary as a control measure. A survey taken in the northern Black Hills indicated an increasing trend. Trees sampled averaged 13" in diameter and ranged in age from 66 to 100 years. Natural control factors were scarce throughout the Forest and were not aiding in checking the beetle outbreak. The need for thinning overstocked stands still remained.

Epidemic levels still persisted in the northern Black Hills during 1964. Surveys indicated that the increased ratio varied from 2:1 to 4:1 in the Elk Mountain, Rochford, and Spearfish District, private and public domain lands within the exemption area, private land north and west of Terry Peak, and State, private and Forest lands in the Four Corner area in northeast Wyoming. Natural control factors were present this year in the Forest and aided to some degree in control of the beetle. Suppression by all land managers was needed in areas of the epidemic. Scattered infested areas needed complete mop-up work. Control measures in South Dakota and Wyoming showed a total of 238,000 infested trees were treated either by salvage logging (34,000), piling and burning (118,000), or chemical treatment (86,000). An intensive suppression program was planned for 79,000 infested trees in 1965.

By the end of 1965, suppression programs had brought about control of the epidemic outbreaks. Predictions were for a static to declining trend. A total of 285,785 infested trees were treated between 1963 and 1965. Infestations still persisted on private land in the southwest corner of the exemption area and the west side of Terry Peak, as well as State and private land in the Four Corner area. There was still a need for proper management of overstocked stands in

the northern Black Hills and treatment of remaining infested stands to insure against further outbreaks. 18,700 trees were treated in 1965. Cold, wet weather in August and September and natural factors (clerid beetles (Enoclerus sphegeus), a predeceous fly (Medetera aldrichii), and several species of mites) aided in controlling the epidemic.

Reports in 1966 indicated that tree losses were low. Many infested trees remained on State and private lands and reinfestation occurred along borders of previously treated areas. Activity was still apparent on Terry Peak, in the Four Corners area, and the exemption area, although the trend was decreasing. Control in these areas was necessary and plans were formulated to try and avoid further drastic losses. Direct control and timber harvesting were recommended.

In 1967, control measures were undertaken by State, private and Federal agencies to contain increasing infestation. Pulpwood cutting and salvage logging replaced chemical control wherever possible. There was an increase in the infestation noted in the northern Black Hills with large increases in the exemption area and northwest of Terry Peak. Predictions were for the infestation to increase. Logging as a control means was used most frequently with emphasis on its use in the exemption area and areas of reinfestation.

In 1968, the Black Hills reported approximately 21,000 infested trees on State and private lands and 35,000 infested trees on National Forest land. Direct control was recommended in those areas where timber harvesting was not in pace with the increasing infestations. The trend was increasing, but past infestations were light and scattered over the forest. Heavy infestations remained on private land in the exemption area and in the Spearfish drainage. A logging program was recommended as a control method in infested areas.

The 1969 trends indicated a static infestation, but losses remained high due to the size of the infestation. A heavy infestation remained on Terry Peak and the exemption area. Mixed ownership of land presented a problem for proper control measures and management. Logging, burning, and chemical use were recommended as control measures in infested areas. Timber sales were used as a tool in control efforts. 17,000 infested trees were treated on 200,000 acres of Forest Service land and 20,000 infested trees were treated on State and private lands.

With the coming of 1970, the legislature of South Dakota passed a bill which affected private landowners having mountain pine beetle infestations. Senate Bill 88 is an act relating to control and suppression of forest insect and disease pests on privately owned forest lands. It insures that an adequate level of forest insect and disease control is accomplished on all privately owned lands and establishes the maximum State-Federal cost-share assistance to a private landowner for such control. The trend in 1970 was static with no apparent changes occurring. 30,000 infested trees were found on 250,000 acres, with the majority located on National Forest and South Dakota Department of Game, Fish and Park lands. It was recommended that basal area be reduced through logging or other means to improve growing conditions. Direct control was used only where losses were intolerable.

In 1971 the Black Hills were plagued with overstocked and stagnated second-growth stands. Infestation levels were increasing--21 million board feet of timber was lost and there were 274,500 newly infested trees. A survey was taken covering 66,540 acres of pine type, having 71,198 trees killed and 174,435 newly infested trees. Another 100,000 infested trees were in the northern Black Hills. Successful control was considered possible only when stands were cut to a low basal area. Stand management was needed in all areas to avoid epidemic outbreaks. Chemical control and burning was only justified on a yearly basis (temporary measure). Logging and timber sales were the main control efforts used to curtail infestations. The major emphasis was on stand management.

A review of the beetle infestation situation since 1957, shows that an outbreak occurred in 1957; treatment began and continued in following years so that by 1960, 20,927 trees had been treated under maintenance control. By 1962, another outbreak occurred in the Limestone area. Treatment followed and by 1965, 285,785 infested trees had been treated. Since 1946, 450,000 trees have been treated, expending about $3,000,000. Since 1967, 92,000 infested trees have been chemically treated and in 1971 some 20 to 25 thousand infested trees were salvage logged.

1972 showed no variation from past occurrences of infestation in the Black Hills. A survey was run throughout the Black Hills and covered 1,628,160 acres with 402,000 newly infested trees. It is estimated that 263,680 acres of intensive activity contained 290,000 newly infested trees. The trend is still increasing and at epidemic levels. Salvage logging and sales have been initiated to remove infested trees. For all practical purposes infestations will continue to increase and at epidemic levels. Control can only be achieved through good stand management and salvage logging with reduction of timber stands to a basal area of 70, and reentry at intervals when called for under management practices to minimize outbreaks of mountain pine beetle.

Conditions in 1973 established through brood counts and ground survey showed increasing population trend. This increasing trend is the basis for continued suppression efforts against the mountain pine beetle.

Regression of a double sample taken in 1972, showed 255,293 $\pm$ 97,283 new faders with a 67% confidence interval. Aerial survey estimates showed another 11,050 new faders outside the photo area. The Black Hills National Forest reported 165,000 trees infested in 1972, were removed through salvage logging. Total estimates of trees infested by beetle flight in 1972 was 431,343, compared with the 402,000 trees infested forcasted. 1973 data was as follows: Photos taken showed 3,062 newly faded trees compared with the ground survey done on 47 plots showing 443 faders to 504 total trees; plot interpreted on the same area. Ground counts to photo interpretation was 1:83 trees. The buildup ratio for 1973 was 1:1.65. Estimation, in the photo survey area, was 422,255 newly attacked trees $\pm$ 188,488 trees at 67% confidence interval. Based on buildup ratios,

there is an estimated 18,277 additional newly attacked trees outside the photo area, giving a total estimate of 440,532 newly infested (1973) trees. Increasing trends indicate that salvage logging and small sales in the infested stands have not kept up with the beetle increase. Additional efforts to remove the infested trees through timber sale programs will help, but mill production must increase if this is to be effective. Direct control is needed in some areas, especially on private land. A long-term solution is expanded timber harvest programs to place stands under management.

Conditions in 1974 for the Black Hills showed no variation from past infestation activity. Results from the 1974 field work indicated a high production of brood and survival rate along with the buildup ratio in three of the four district areas sampled being greater than 1:1. Therefore, an excess of 470,000 merchantible size ponderosa pine will eventually be killed in the Black Hills of South Dakota and Wyoming in 1974.

The emphasis in 1974 remains to be salvage logging of currently infested trees. In 1973, 348,000 infested trees were left standing due to various reasons. As of November 1974, 192,000 infested trees had been sold. As industry conditions change, additional 1974 infested trees may be removed.

Stand management gives the greatest return on an investment than suppression projects. For this to be accomplished, there is a need for increased TM funding, the annual allowable cut and local mill capacity. Since salvage logging continues to be the main emphasis in 1974, suppression efforts persist. Chemical treatment and burning are alternatives for those invested trees that cannot be logged. Primary use of alternative methods should be in salvage logged areas to maintain complete treatment or in high value areas.

REVIEW OF SECONDARY INFESTATION PROBLEMS IN THE BLACK HILLS

Reports made in 1902, by A.D. Hopkins, mentioned that secondary insects were noted in the Black Hills during the mountain pine beetle outbreak. Noted at this time were: Ips pini (Say) (= Tomicus oregoni (Eichh.)); the coarse writing beetle, Ips calligraphus (Germ.) (= Tomicus calligraphus (Germ.) var. occidentalis; the wood-engraving tomicus, Orthotomicus caelatus (Eichh.) (= Tomicus caelatus (Eichh.)); the red turpentine beetle, Dendroctonus valens (Lec.); the western pine hylurgops, Hylurgops subcostulatus (Mann.)); and the pine root bark beetle, Hylurgops porosus (Lec.) (= Hylastes porous (Lec.)).

There is no account given of secondary insects in the periods from 1902 to 1933. In that year (1933), the Black Hills Forest reported an outbreak of Ips pini (Say). It was stated that the insect was widespread throughout the Forest and found mainly in the stands thinned to control mountain pine beetle. Also noted was the pine tip moth, Rhyacionia neomexicana (Dyar). This insect affected the buds and new growth on ponderosa pine. The report didn't mention how widespread it was. The Harney Forest reported I. pini (Say), in slash, resulting from a thinning operation. Areas where blowdown had occurred also showed an increase of this insect. Sawfly was also reported on the entire area south of Custer and was listed in epidemic proportions and showing increasing trends. It was reported defoliating ponderosa pine. A stomach poison was recommended for control.

The tip moth, Rhyacionia frustrana bushnelli (Busck.), was also reported on the forest. The Black Hills Forest reported Ips still present in 1934. It was stated that I. pini was responsible for most of the damage in the forest that year. Control work was continuing. The Harney Forest indicated that I. pini was responsible for most of the damage in the forest that year. The Harney Forest indicated that I. pini was present in thinned and cyclone-hit areas. 5,000 acres were hit by sawflys and control measures were hard to implement due to the wide area affected. Needle damage by needle scale also affected ponderosa pine, killing numerous trees.

Little change occurred in 1935 with I. pini causing most of the damage in the Black Hills forest. It was mainly found in thinned and developed areas. Harney reported the presence of Dendroctonus valens but there were only a few attacks. I. pini was reported heavy in timber sales and thinned areas. The sawfly was said to have decreased from epidemic levels.

The only activity in 1936 on the Black Hills Forest, was by I. pini and D. valens . Ips were reported still active and the turpentine beetle, was reported decreasing in number, but still active. Harney reported the presence of D. valens but no appreciable damage was done. There was a large outbreak of Ips. Tip moth was present in small reproduction areas doing heavy damage. The sawfly infestation was declining due to parasite activity.

In 1937, the Black Hills Forest reported no serious damage by Ips. The Harney Forest reported its Ips population declining, and birth leaf skeletonizer infestation was reduced due primarily to climatic conditions. Tip moth damage was still present, and sawfly activity continued to decline due to parasite activity. D. valens was reported in outbreak conditions around mill sites and log cutting areas.

Secondary insect problems had subsided on the Black Hills Forest in 1938, and there was no reported occurrences of damage. The Harney Forest reported I;s did heavy damage in the Bolas Canyon and Elk Mountain areas and hit 500 to 1,000 immature and merchantable trees. The Forest indicated that the infestation was on the decline. Midwestern pine tip moth was reported widespread and doing heavy damage. No control measures were taken. The pine sawfly was on the decline as well as the turpentine bark beetle. The birch leaf skeletonizer was reported as no threat to the Forest. Webworm was found affecting chokecherry in the Elk Mountain and Limestone country. No control measures were taken.

Increasing amounts of precipitation in 1962 over the Black Hills reduced the oregon pine engraver to a point where it was not foreseen as a serious problem.

A report in 1963 indicated heavy defoliation of aspen and birch trees by a leaf beetle in the genus Chrysomela.

The Black Hills reported in 1964, activity of the oregon pine Ips. Treatment on the Experimental Forest was done and endemic conditions were reported on the forest. The leaf beetle was reported still active and heavy defoliation was found on birth and aspen stands.

The next three years showed activity by secondary insects in the Black Hills to be minimal or nonexistent. There is no mention of activity in reports.

The insect conditions report in 1967 stated that the leaf beetle was present in the Black Hills and defoliating some aspen stands. The extent of the damage was not given.

The report in 1968 shows that the northern Black Hills had heavy defoliation caused by the spear-marked black moth (Eulype Hastata Gothicata (Guen)).

Again in 1969, the spear-marked black moth caused heavy defoliation to birch stands in the northern Black Hills.

From 1969 to the present time (1972) no accounts are given for secondary insect damage. Their presence apparently was minimal--not important enough to report. The main insect pest in the Black Hills continues to be the mountain pine beetle.

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Biological Evaluation--Black Hills Beetle Infestation, Black Hills NF October 1967.

1968

Division of Timber Management. Forest Insect Conditions in U.S., 1968. (Central Rocky Mountains) USDA - Forest Service, Denver, Colorado.

Biological Evaluation--Black Hills Beetle Infestation, Northern Black Hills. August 1968.

1969

Division of Timber Management. Forest Insect Conditions in U.S., 1969. (Central Rocky Mountains) USDA - Forest Service, Denver, Colorado.

Biological Evaluation--Mountain Pine Beetle Infestation, Northern Black Hills. August 1969.

1970

Division of Timber Management. Forest Insect Conditions in U.S., 1970. (Central Rocky Mountains) USDA - Forest Service, Denver, Colorado.

Biological Evaluation--Mountain Pine Beetle, Northern Black Hills. October 1970.

1971

Division of Timber Management. Forest Insect Conditions in U.S., 1971. (Central Rocky Mountains) USDA - Forest Service, Denver, Colorado

Biological evaluation--Mountain Pine Beetle, Black Hills NF, Northern Black Hills; Lead-Deadwood Area, South Dakota. September 1971.

Biological evaluation--Mountain Pine Beetle, Black Hills NF, Bearlodge District, BLM, and State of Wyoming. October 1971.

1972

Biological Evaluation--Mountain Pine Beetle, Black Hills of South Dakota and Wyoming. October 1972.

1973

Biological Evaluation--Mountain Pine Beetle, Black Hills of South Dakota and Wyoming. December 1973.

1974

Biological Evaluation--Black Hills National Forest and Adjacent State and Private Lands